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EXECUTIVE SUMMARY

This paper is designed to relate the rationale used by the Department of Defense to determine the military utility of the Joint Medical Operations – Telemedicine Advanced Concept Technology Demonstration (JMO-T ACTD). The paper also develops Critical Operational Issues (COI) and Measures of Effectiveness (MOE) as methodologies for investigating the military utility of telemedicine. In order to meet increasing global crises, the U.S. military must find ways to more effectively manage manpower and time. Joint Medical Operations – Telemedicine (JMO-T) has been developed by the Department of Defense (DOD) to collect and transmit near-real-time, far-forward medical data and to assess how this improved capability enhances medical management of the battlespace. JMO-T has been successful in resolving uncertain organizational and technological military deficiencies and in improving medical communications and information management. The deployable, mobile Telemedicine Teams are the centerpieces of JMO-T. These teams have the capability of inserting essential networking and communications capabilities into austere theaters and establishing an immediate means for enhancing health protection, collaborative planning, situational awareness, and strategic decision-making.

CASE DESCRIPTION

A suite of software, databases, and architecture standards have been adapted, by the armed forces, to provide deployable medical information management. The Theater Medical Core Services (TMCS) is a database that stores data locally and is capable of sending encrypted e-mail to several redundant database servers via store-and-forward. The database servers aggregate information and store it in databases for distribution. Web servers supply data to medical personnel as customized encrypted reports.

The Medical Workstation (MeWS) is a network-based workstation equipped with portable medical devices, clinical support capabilities, medical information support, and a graphical user interface. The MeWS will support multi-patient monitoring, interface with the patient's clinical record, and provide access to a searchable database. It will also provide full Personal Information Carrier (PIC) read and write implementation. MeWS collect, store, and forward medical device data and images. By utilizing a Global Positioning System (GPS), MeWS have the capability to enter the patient's geographical location. The various software components of the MeWS help to facilitate clinical data entry, acquisition and retrieval. MeWS enable the generation of medical facility status reports, the monitoring of disease surveillance, the updating of supplies, and tracking of evacuation requirements.

The Field Medical Surveillance System (FMSS) is an expert system that systematically detects and monitors epidemiological trends and profiles patient populations. FMSS integrates patient information to the Global Infectious Disease and Epidemiology Network (GIDEON) knowledge base. Demographic and symptomatic information is used to arrive at a presumptive diagnosis or classify the patient using discriminate analysis. FMSS is also capable of providing incidence and prevalence trends for infectious diseases.

The Libretto is a commercial-off-the-shelf (COTS) hand held computer, manufactured by Toshiba. It has the capability to automate field medic PIC card software by reading service member's demographic information from the PIC into the software. It can also write GPS medical encounter information to the PIC and store the information as a pre-formatted message for transmission.

Tactical medical communications require updating of the existing IT infrastructure. The previously mentioned novel hardware, software, and interfaces were implemented in order to enable this change and facilitate the transmission of medical-unique information over the existing communications hardware and command, control, communication, computers, intelligence, surveillance, and reconnaissance (C4ISR) networks. However, telecommunications from the operational area of responsibility (AOR) to the medical sustaining base uses the existing Defense Information Systems Network (DISN).

The technologies described above have been assembled into an exportable capability that is specifically tailored to meet the medical Information Management (IM) and Information Technology (IT) needs of the unit it is supporting. This assemblage of technologies is referred to as the Capability Package. The capability package must work in concert with the unit's infrastructure, communications, tactical situation, and logistical constraints if the military is to realize its full potential in meeting today's global crises.

CURRENT CHALLENGES/PROBLEMS

The present crisis in Kosovo has provided an opportunity to test the telemedicine system. Many U.S. troops man remote military outposts in Bosnia that are inaccessible due to poor road infrastructure, bad weather, or numerous land mines. Despite this isolation, medics are well equipped to treat the soldiers stationed there. The suite of telemedicine gear that is available links them to medical specialists worldwide. For example, a spider bite resulted in a rash on a Bosnian peacekeeper's arm. The soldier's vital signs were transmitted, via the telemedicine suite infrastructure, to a specialist at Walter Reed Hospital in Washington D.C. The specialist confirmed the medic's diagnosis and recommended treatment. The condition cleared up within several days.

In another application of JMO-T technology, a medic performed a minor operation for a sinus infection under the guidance of a remote specialist. In northern Bosnia, a physician's assistant experienced a rapid heartbeat that may have deteriorated into a life threatening arrhythmia. EKG images sent over the telemedicine link allowed a higher echelon cardiologist in Tuzla to direct the on site administration of medication that slowed the heart rate. All of these conditions could have resulted in a costly and dangerous medical evacuation, had the situation not been remedied in the far forward remote location.

Telemedicine in Bosnia has many advantages for the troops deployed there. First, it has established a real time automated patient record keeping system. Second, it will keep evacuations to a minimum and maximize return to duty. Third, it will provide for a rapid response to trauma. Fourth, it will guarantee high quality health care to soldiers. Finally, it will provide the big picture for medical decision-makers, enabling them to implement concurrent medical support.

Training in the use of JMO-T Capability Package is essential. In Bosnia, medical personnel receive intensive training on the applications of telemedicine. Training is provided by the Medical Advanced Technology Management Office (MATMO). Manuals and handouts are periodically updated to ensure that the forward medical units in Bosnia are provided with the most recent advances in telemedicine. Troubleshooting is an important aspect in the smooth operation and maintenance of the Capability Package.

There is a strong likelihood that the hostilities in Bosnia will continue, and it is fortunate for our military that the telemedicine capability packages are in place. Lives will be saved and costly medical evacuations curtailed by the application of the JMO-T suite of gear. JMO-T has enabled a paradigm shift in battlefield medicine, and it has the capability of leveraging the scarce resources of Bosnian peacekeepers.

The JMO-T capability package is constantly being tested and evaluated (T&E) to improve effectiveness and efficiency. Kernel Blitz, a seven day exercise off the California coast, provided a T&E opportunity to gather data ranging from the number of records sent and received to top level perceptions of the success of the JMO-T effort. T&E data was gathered from the Patriot Medstar exercise in Idaho and California, and from Pacific Warrior in Hawaii. The capstone exercise, Cobra Gold, will be conducted in Thailand during May of 2000.

In summary, telemedicine effectively minimizes the military forward footprint during times of war, by utilizing distributed computing power, human expertise, and connectivity to provide medical care throughout the world. During peace, telemedicine is critical in maintaining the health and readiness of the U.S. military forces, so that they can provide real-time responses to disasters. Telemedicine is helping the joint armed forces to meet global crises at the speed of thought.

CURRENT STATUS OF THE PROJECT

To insure that the information system architecture closely fits the operational architecture, the JMOT-ACTD continues to be tested and evaluated. In the testing and evaluation, system statistics are compared to existing benchmarks and standards. According to the results of the various exercises, the JMO-T has successfully fulfilled the requirements of the ACTD. For example, the results of the Pacific Warrior exercise, conducted in Hawaii, suggest that the JMO-T data can be transmitted consistently and reliably. Signal quality, system availability, software and hardware reliability and sustainability of each JMO-t system was assessed and found to meet or exceed standards set prior to the exercise. For example, there were no failure rates in message transmission by node. In other words, 100% of messages sent by the far forward mobile units were received at their destination. No failures were reported for the application servers, Netscape communicators, Oracle Databases, Libretto Computers, or Smartcard readers within the network. Signal quality was reflected by the results of software tests between the WavePoint and a remote unit taken to various spaces in the facility. The data reflected adequate signal strength for approximately 450 feet in all directions. More than 100 MB of data was successfully moved between two servers. One specific file transfer test sent a single file of 244,736 bytes to every client in the network. Server uptime was 4871 out of 4905 minutes for 99.3% availability for one server and 4905 minutes for the other server (100%). The Libretto sub-notebook hardware were operational 99.7% of the time, over the course of the exercise. The Smartcard software was successfully read 96.2% of the

time. The webserver was highly reliable and processed 17,863 requests, with only four requests trapped as errors.

SUCCESSES AND FAILURES

Testing and evaluation of the JMO-T ACTD has produced tangible evidence for the military utility of Telemedicine. Exercise results from Pacific Warrior-99 (PW-99) indicate that the essential data transport requirements of JMO-T can be met consistently, reliably, and cost effectively. Cost parameters were gathered for each candidate system and presented in a matrix to serve as the basis for cost tradeoff analysis for operational managers. Specific technologies were examined relative to each other for specific operational requirements of data throughput, transmission distance, time to setup, time to train, and actual costs to acquire, maintain and dispose. These architectural elements selected for PW-99 reflect a first iteration of the cost parameter matrix. The data collected at PW-99 on ease of use, performance, reliability, and consistency will contribute to the cost parameter matrix and assist in determining the relative costs of systems. It must be noted that the cost associated with this criterion is based solely on the costs of transmitting data and does not include the cost of communication assets, JMO-T ACTD systems infrastructure, time, the value of providing care to a patient, or the value of a person.

Several parameters could not be measured directly by the field exercise at PW-99. These parameters will be determined through the use of laboratory testing and evaluation methods. For example, analysis still is not complete on the availability of high frequency and very high frequency radios, the overall reliability of the Toughbook laptops, the software reliability of several of the communication modules, and the sustainability of several of the software, hardware, networks and databases used in the exercise. As new data becomes available through laboratory testing, a more complete picture of the military utility of telemedicine will evolve.

EPILOGUE AND LESSONS LEARNED

Lessons were learned and are still being learned from the JMO-T ACTD for determining the military utility of telemedicine. Improved consistency, reliability, and cost effectiveness have been demonstrated in several field exercises. Underestimating the military utility of Telemedicine could lead to increased costs of medical evacuations, increased costs for logistical support, and increased costs in terms of human lives. Furthermore, the utility of telemedicine cannot be measured solely in terms of war. Telemedicine also has utility during peacetime. Armed forces that lack adequate preventative and primary care have lower morale and lack a sense of family well being. In turn, these attitudes could have an effect on military preparedness. The military utility of telemedicine helps the Department of Defense to avoid these undesirable consequences.

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